# TECHNICAL INFORMATION

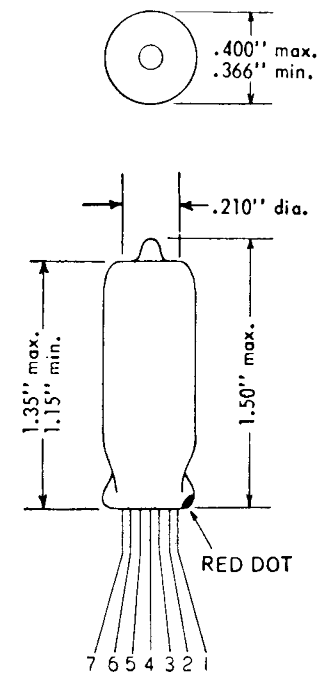
RAYTHEON

*Excellence in Electronics*

RELIABLE SUBMINIATURE PENTODE

# TYPE CK5784WB

The CK5784WB is a heater-cathode type pentode of subminiature construction capable of operation in the VHF region. The control grid and suppressor grid may be used as independent control electrodes for circuits such as gated amplifiers, mixers, and gain controlled amplifiers. This tube is characterized by long life and stable performance. It is designed for service where severe conditions of high temperature and mechanical shock or vibration are encountered. The flexible terminal leads may be soldered or welded directly to the terminals of circuit components without the use of sockets. Standard inline subminiature sockets may be used by cutting the leads to a suitable length.




## MECHANICAL DATA

ENVELOPE: T-3 Glass

BASE: None (0.016" tinned flexible leads. Length: 1.5" min.
Spacing: (0.048" center-to-center)

TERMINAL CONNECTIONS: *(Red Dot is adjacent to lead 1)*

| | |
|---|---|
| Lead 1 Plate | Lead 5 Grid #1 |
| Lead 2 Grid #2 | Lead 6 Cathode |
| Lead 3 Heater | Lead 7 Grid #1 |
| Lead 4 Heater | |

MECHANICAL RATINGS:

| | |
|---|---|
| Maximum Impact Acceleration (Shock Test – Note 3) | 450 G |
| Maximum Uniform Acceleration (Centrifuge Test – Note 4) | 1000 G |
| Maximum Vibrational Acceleration (96 Hour Fatigue Test – Note 5) | 2.5 G |
| Maximum Bulb Temperature | 220 °C |

MOUNTING POSITION: Any

## ELECTRICAL DATA

CAUTION-----To Electronic Equipment Design Engineers: Special attention should be given to the temperature at which the tubes are to be operated. Reliability will be seriously impaired if maximum bulb temperature is exceeded. The life expectancy may be reduced if conditions other than those specified for life test are imposed on the tube and will be reduced appreciably if maximum ratings are exceeded. Life and reliability of performance are closely related to the degree that regulation of the heater voltage is maintained at its center rated value.

| RATINGS AND NORMAL OPERATION: | MIL-E-1 SYMBOL | DESIGN MINIMUM | NORMAL TEST CONDITIONS (Note 7) | NORMAL OPERATION (Note 6) | DESIGN MAXIMUM | MIL-E-1 UNITS |
|---|---|---|---|---|---|---|
| Heater Voltage (Note 8) | Ef: | 5.7 | 6.3 | 6.3 | 6.9 | V |
| Plate Voltage | Eb: | ---- | 120 | 120 | 165 | Vdc |
| Grid #1 Voltage | Ec1: | –55 | 0 | 0 | 0 | Vdc |
| Grid #2 Voltage | Ec2: | ---- | 120 | 120 | 155 | Vdc |
| Grid #3 Voltage | Ec3: | –55 | 0 | 0 | 30 | Vdc |
| Plate Dissipation | Pp: | ---- | ---- | 0.65 | 0.79 | W |
| Grid #2 Dissipation | Pg2: | ---- | ---- | 0.5 | 0.6 | W |
| Grid #1 Circuit Resistance | Rg1: | ---- | ---- | 1.0 | 1.2 | Meg. |
| Heater-Cathode Voltage | Ehk: | –200 | ---- | 100 | +200 | v |
| Cathode Current | Ik: | ---- | ---- | ---- | 16.5 | mAdc |
| Grid #1 Current | Ic1: | ---- | ---- | ---- | 1.0 | mAdc |
| Grid #3 Current | Ic3: | ---- | ---- | ---- | 0.2 | mAdc |
| Cathode Resistance | Rk: | ---- | 230 | 230 | ---- | ohms |
| Plate Current (1) | Ib (1): | ---- | ---- | 5.5 | ---- | mAdc |
| Grid #2 Current | Ic2: | ---- | ---- | 4.1 | ---- | mAdc |
| Transconductance (1) | Sm (1): | ---- | ---- | 3200 | ---- | µmhos |

Tentative Data

## ELECTRICAL DATA (Cont'd)

### CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1)

| TEST | CONDITIONS | AQL % | MIL-E-1 SYMBOL | MIN | LAL | BOGIE | UAL | MAX | ALD | MIL-E-1 UNITS |
|---|---|---|---|---|---|---|---|---|---|---|
| **MEASUREMENTS ACCEPTANCE TESTS PART 1** | | | **Combined AQL = 1.0% excluding Mechanical and Inoperatives** | | | | | | | |
| Heater Current: | | 0.65 | If: | 190 | ---- | 200 | ---- | 210 | ---- | mA |
| Heater – Cathode Leakage: | Ehk=+100 Vdc<br>Ehk=–100 Vdc | 0.65 | Ihk:<br>Ihk: | ----<br>---- | ----<br>---- | ----<br>---- | ----<br>---- | 5<br>5 | ----<br>---- | μAdc<br>μAdc |
| Grid Current (1): | | 0.65 | Ic1 (1): | ---- | ---- | ---- | ---- | –0.3 | ---- | μAdc |
| Plate Current (1): | | 0.65 | Ib (1): | 3.9 | 4.8 | 5.5 | 6.2 | 7.1 | 2.5 | mAdc |
| Transconductance (1): | | 0.65 | Sm (1): | 2650 | 2900 | 3200 | 3500 | 3950 | 900 | μmhos |
| Continuity and Shorts (Inoperatives): | | 0.4 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Mechanical: | Envelope (9–7) (Note 10) | | | | | | | | | |
| **MEASUREMENTS ACCEPTANCE TEST PART 2** | | | | | | | | | | |
| Insulation of Electrodes: | Ef=6.3V<br>Eg1–all=–100 Vdc<br>Eg3–all=–100 Vdc<br>Ep–all=–300 Vdc | 2.5 | Rg1-all:<br>Rg3-all:<br>Rp-all: | 100<br>100<br>100 | ----<br>----<br>---- | ----<br>----<br>---- | ----<br>----<br>---- | ----<br>----<br>---- | ----<br>----<br>---- | Meg.<br>Meg.<br>Meg. |
| Plate Current (2): | Ec3=–10 Vdc (Note 14) | 2.5 | Ib (2): | ---- | ---- | ---- | ---- | 200 | ---- | μAdc |
| Plate Current (3): | Ec3= –6 Vdc (Note 14) | 2.5 | Ib (3): | 5 | ---- | ---- | ---- | ---- | ---- | μAdc |
| Plate Current (4): | Ec1=–9 Vdc | 2.5 | Ib (4): | ---- | ---- | ---- | ---- | 200 | ---- | μAdc |
| Plate Current (5): | Ec1=–5 Vdc | 2.5 | Ib (5): | 5 | ---- | ---- | ---- | ---- | ---- | μAdc |
| Screen Current: | | 2.5 | Ic2: | 2.8 | ---- | ---- | ---- | 5.4 | ---- | mAdc |
| Transconductance (2): | Ef=5.7V (Note 9) | 2.5 | $\Delta_{Ef}$Sm(2): | ---- | ---- | ---- | ---- | 10 | ---- | % |
| Grid Emission: | Ef=7.5V; preheat 5 minutes at Ec1=0; Test at Ec1=–10 Vdc | 6.5 | Ic1 (2): | ---- | ---- | ---- | ---- | –0.5 | ---- | μAdc |
| AF Noise: | Esig=70 mVac; Ec2=19 Vdc; Rg1=0.1 Meg; Rg2=1000 ohms; Rp=0.2 Meg; Ck=1000 μf | 2.5 | EB: | ---- | ---- | ---- | ---- | 17 | ---- | VU |
| Capacitance:<br>Capacitance:<br>Capacitance: | (Note 2) | 6.5 | Cg1p:<br>Cin:<br>Cout: | ----<br>3.5<br>2.8 | ----<br>----<br>---- | ----<br>4.5<br>3.6 | ----<br>----<br>---- | 0.03<br>5.5<br>4.4 | ----<br>----<br>---- | μμf<br>μμf<br>μμf |
| Transconductance (3): | Ec3=–1.0 Vdc (Note 14) | 6.5 | Sg3–P: | 400 | ---- | ---- | ---- | 1100 | ---- | μmhos |
| Transconductance (4): | Ec3=+22 Vdc (Note 14) | 6.5 | Sg3–P: | ---- | ---- | ---- | ---- | 25 | ---- | μmhos |
| Low Pressure Voltage Breakdown: | Pressure=55±5 mm Hg; Voltage=300 Vac | 6.5 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Operation Time: | (Note 11) | 4.0 | t: | ---- | ---- | ---- | ---- | 20 | ---- | sec. |
| Vibration (2): | F=40 cps; G=15; Rp=10,000 ohms | 2.5 | Ep: | ---- | ---- | ---- | ---- | 75 | ---- | mVac |
| Vibration (3): | F=30–1000 cps; G=15; Rp=10,000 ohms; t=3 minutes; positions $X_1$ and $X_2$ only | 4.0 | Ep: | ---- | ---- | ---- | ---- | 300 peak to peak | ---- | mv |
| **DEGRADATION RATE ACCEPTANCE TESTS** | | | | | | | | | | |
| Subminiature Lead Fatigue: | | 2.5 | ---- | 4.0 | ---- | ---- | ---- | ---- | ---- | arcs |
| Shock (1): | Ehk=+100 Vdc; Rg=0.1 Meg. Hammer Angle=30° (Note 3) | 20 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Fatigue (1): | 96 hours; G=2.5; Fixed frequency; F=25 min., 60 max. (Note 5) | 6.5 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| Fatigue (2): | 6 hours; G=10; Fixed frequency; F=25 min., 60 max. (Note 12) | 6.5 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |

## ELECTRICAL DATA (Cont'd)

### CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

| TEST | CONDITIONS | AQL % | MIL-E-1 SYMBOL | MIN | MAX | MIL-E-1 UNITS | Allowable Defects per Characteristic 1st Sample | Combined Samples |
|---|---|---|---|---|---|---|---|---|
| **DEGRADATION RATE ACCEPTANCE TESTS** | | | | | | | | |
| Post Shock (1) and Fatigue Tests (1) and (2) End Points: | | | | | | | | |
| Vibration (2): | F=40 cps; G=15; Rp=10,000 ohms | ---- | Ep: | ---- | 125 | mVac | | |
| Heater-Cathode Leakage: | Ehk=+100 Vdc | ---- | Ihk: | ---- | 20 | μAdc | | |
| | Ehk=−100 Vdc | ---- | Ihk: | ---- | 20 | μAdc | | |
| Change in Transconductance (1) of individual tubes: | Ef=6.3 V | ---- | $\Delta_t$Sm (1): | ---- | 15 | % | | |
| Grid Current (1): | | ---- | Ic1 (1): | ---- | −1.0 | μAdc | | |
| Shock (2): | Ehk=+100 Vdc; Rg=0.1 Meg.; G=75; (hammer angle=120°+rubber pad); t=10 milliseconds duration (Note 13) | 20 | ---- | ---- | ---- | ---- | | |
| Post Shock Test (2) End Points: | | | | | | | | |
| Vibration (2): | F=40 cps; G=15; Rp=10,000 ohms | ---- | Ep: | ---- | 125 | mVac | | |
| Heater-Cathode Leakage: | Ehk=+100 Vdc | ---- | Ihk: | ---- | 20 | μAdc | | |
| | Ehk=−100 Vdc | ---- | Ihk: | ---- | 20 | μAdc | | |
| Change in Transconductance (1) of individual tubes: | Ef=6.3 V | ---- | $\Delta_t$Sm (1): | ---- | 15 | % | | |
| Grid Current (1): | | ---- | Ic1 (1): | ---- | −1.0 | μAdc | | |
| Glass Strain (Thermal Shock): | | 6.5 | ---- | ---- | ---- | ---- | | |
| **ACCEPTANCE LIFE TESTS** | | | | | | | | |
| Heater Cycle: | Ef=7.5 V; Eb=Ec1=Ec2=Ec3=0V; Ehk=140 Vac; 1 min. on, 1 min. off. | 1.0 | ---- | 2000 | ---- | cycles | | |
| Heater Cycling Life Test End Points: | | | | | | | | |
| Heater-Cathode Leakage: | Ehk=+100 Vdc | ---- | Ihk: | ---- | 20 | μAdc | | |
| | Ehk=−100 Vdc | ---- | Ihk: | ---- | 20 | μAdc | | |
| 1 Hour Stability Life Test: | TA=room; Ehk=+200 Vdc; Rg1=1.0 Meg. | ---- | ---- | ---- | ---- | ---- | | |
| 1 Hour Stability Life Test End Points: | | | | | | | | |
| Change in Transconductance (1) of individual tubes: | (Typical sample size=50 tubes) | 1.0 | $\Delta_t$Sm (1): | ---- | 10 | % | | |
| 100 Hour Survival Rate Life Test: | TA=room; Ehk=+200 Vdc; Rg1=1.0 Meg. | ---- | ---- | ---- | ---- | ---- | | |
| 100 Hour Survival Rate Life Test End Points: | (Typical sample size=200 tubes) | ---- | ---- | ---- | ---- | ---- | | |
| Inoperatives: | | 0.65 | ---- | ---- | ---- | ---- | | |
| Transconductance (1): | | 1.0 | Sm (1): | 2400 | ---- | μmhos | | |
| Intermittent High Temperature Life Tests: | T Bulb=220°C; Ehk=+200 Vdc; Rg1=1.0 Meg. | ---- | ---- | ---- | ---- | ---- | | |

## ELECTRICAL DATA (Cont'd)

### CHARACTERISTICS AND QUALITY CONTROL TESTS (Note 1) (cont'd)

| TEST | CONDITIONS | AQL % | MIL-E-1 SYMBOL | MIN | MAX | MIL-E-1 UNITS | Allowable Defects per Characteristic 1st Sample | Combined Samples |
|---|---|---|---|---|---|---|---|---|
| **ACCEPTANCE LIFE TESTS (cont'd)** | | | | | | | | |
| 500 Hour Intermittent High Temperature Life Test End Points: | (Typical sample size= 20 tubes 1st sample, 40 tubes 2nd sample) | ---- | ---- | ---- | ---- | ---- | | |
| Inoperatives: | | ---- | ---- | ---- | ---- | ---- | 1 | 3 |
| Grid Current (1): | | ---- | Ic (1): | ---- | −0.6 | μAdc | 1 | 3 |
| Heater Current: | | ---- | If: | 188 | 212 | mA | 1 | 3 |
| Change in transconductance (1) of individual tubes: | | ---- | $\Delta_t$Sm(1): | ---- | 20 | % | 1 | 3 |
| Transconductance (2): | (Note 9) | ---- | $\Delta_{Ef}$Sm(2): | ---- | 15 | % | 2 | 5 |
| Heater-Cathode Leakage: | Ehk=+100 Vdc | ---- | Ihk: | ---- | 10 | μAdc | 2 | 5 |
| | Ehk=−100 Vdc | ---- | Ihk: | ---- | 10 | μAdc | | |
| Insulation of Electrodes: | | | | | | | | |
| g1−all | | ---- | Rg1−all: | 50 | ---- | Meg. | 2 | 5 |
| g3−all | | ---- | Rg3−all: | 50 | ---- | Meg. | | |
| p−all | | ---- | Rp−all: | 50 | ---- | Meg. | | |
| Transconductance (1) Average Change: | | ---- | Avg $\Delta_t$Sm(1): | ---- | 15 | % | --- | --- |
| Total Defectives: | | ---- | ---- | ---- | ---- | ---- | 4 | 8 |
| 1000 Hour Intermittent High Temperature Life Test End Points: | (Typical Sample Size= 20 tubes 1st sample, 40 tubes 2nd sample) | ---- | ---- | ---- | ---- | ---- | --- | --- |
| Inoperatives: | | ---- | ---- | ---- | ---- | ---- | 2 | 5 |
| Grid Current (1): | | ---- | Ic (1): | ---- | −1.0 | μAdc | 2 | 5 |
| Heater Current: | | ---- | If: | 188 | 212 | mA | 2 | 5 |
| Change in transconductance (1) of individual tubes: | | ---- | $\Delta_t$Sm(1): | ---- | 25 | % | 2 | 5 |
| Heater−Cathode Leakage: | Ehk=+100 Vdc | ---- | Ihk: | ---- | 15 | μAdc | 2 | 5 |
| | Ehk=−100 Vdc | ---- | Ihk: | ---- | 15 | μAdc | | |
| Total Defectives | | ---- | ---- | ---- | ---- | ---- | 5 | 10 |

NOTES

Note 1: Characteristics, Quality Control Test Procedures, and Inspection Levels are made according to the appropriate paragraphs of MIL-E-1 "Inspection Instructions for Electron Tubes" and MIL-STD-105A.

Note 2: Wigh a cylindrical shield (0.405" I.D.−1 7/8" long) connected to lead 6.

Note 3: Test conditions and acceptance criteria per Shock Test Procedures of MIL-E-1 basic specification.

Note 4: Centrifuge Test with forces applied in any direction.

Note 5: Test conditions and acceptance criteria per Fatigue Test Procedures of MIL-E-1 basic specifications.

Note 6: These normal values represent conditions at which control of reliability may be expected.

Note 7: These normal test conditions are used for all characteristic tests unless otherwise stated under the individual test item.

## ELECTRICAL DATA (Cont'd)

NOTES (cont'd)

Note 8: For most applications the performance will not be adversely affected by ± 10% heater voltage variation, but when the application can provide a closer control of heater voltage, an improvement in reliability will be realized.

Note 9: Change of transconductance for individual tubes from that value measured at Ef=6.3 V to that value measured at Ef=5.7 V.

Note 10: In addition to meeting the tightened electrical, physical and mechanical tests described in this data sheet Raytheon Reliable Tubes are now guaranteed to be free from "potential" defects identifiable by microscopic inspection as described by appendix B of "Inspection Instructions for Electron Tubes."

Note 11: Operation time is the time in seconds required for the plate current to attain a value within plus or minus 10 percent of the three minute plate current (1) value using a cold tube. No preheating before this test will be allowed.

Note 12: The tubes shall be rigidly mounted on a table vibrating with simple harmonic motion. The tubes shall be vibrated for a total of 6 hours, 2 hours in each of three positions, X1, X2 and Y1. Only rated heated voltage shall be applied. Tubes which show one or more of the following defects shall be considered failures.

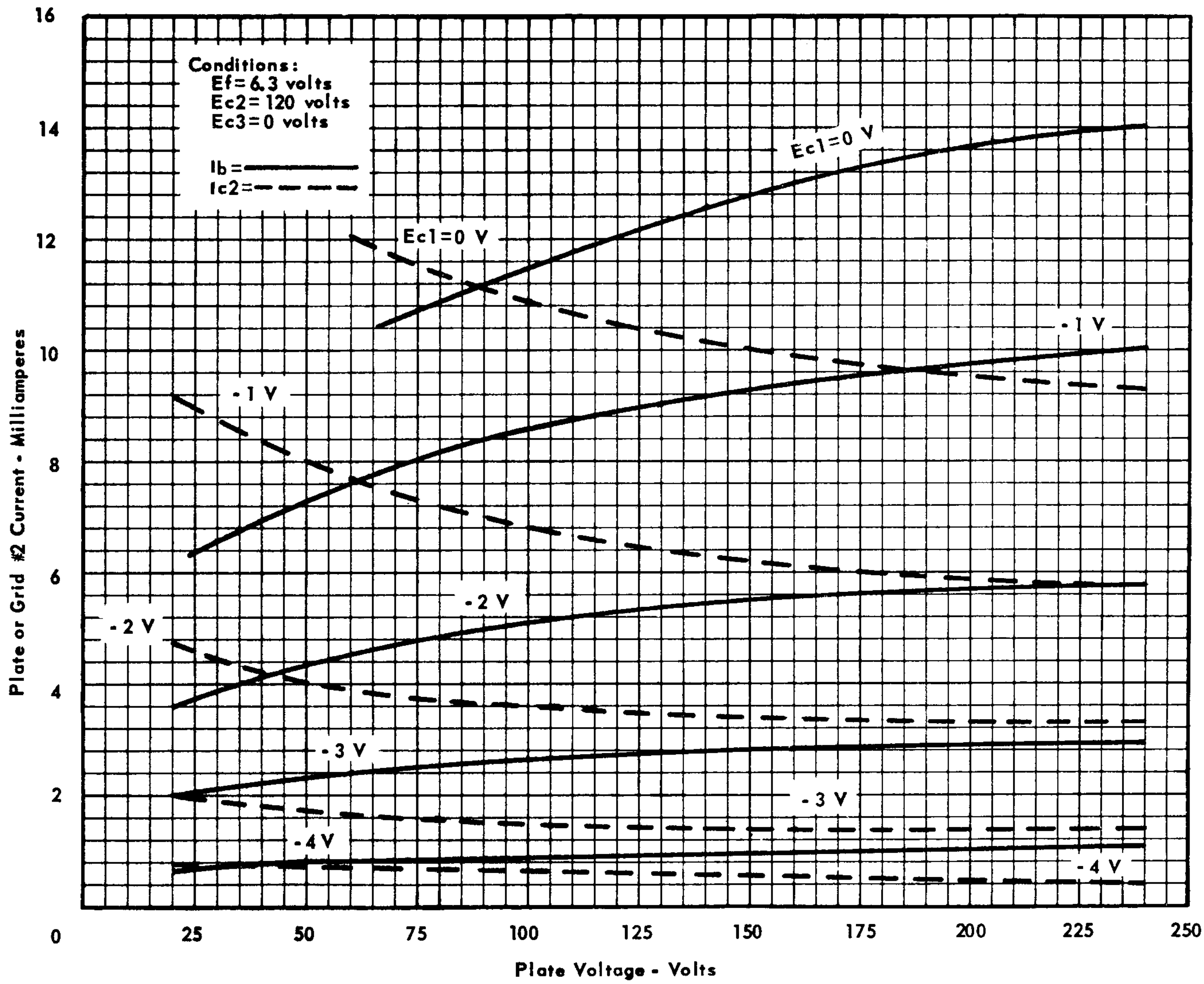
(a) Tubes which show permanent or tap shorts or open circuits following fatigue test, when tested as specified in 4.7.2 and 4.7.3.

(b) Tubes which do not comply with post fatigue limits. This is a destructive test.

Note 13: The provisions of paragraph 4.9.20.5 of Specification MIL-E-1 shall apply, except for test conditions listed for shock test (2).

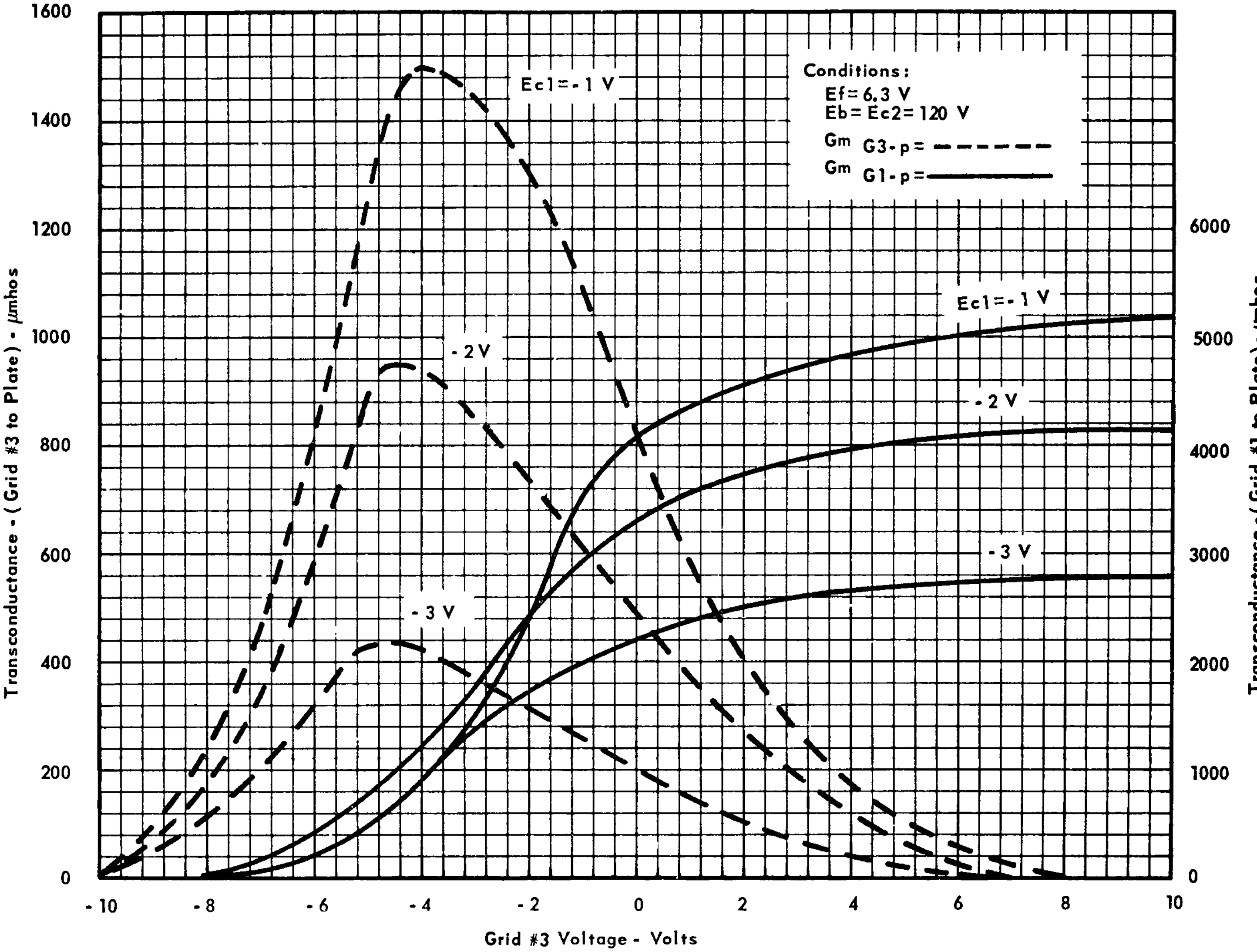
Note 14: The reference point for Ec3, on this test, shall be the negative side of the cathode resistor.

AVERAGE PLATE CHARACTERISTICS

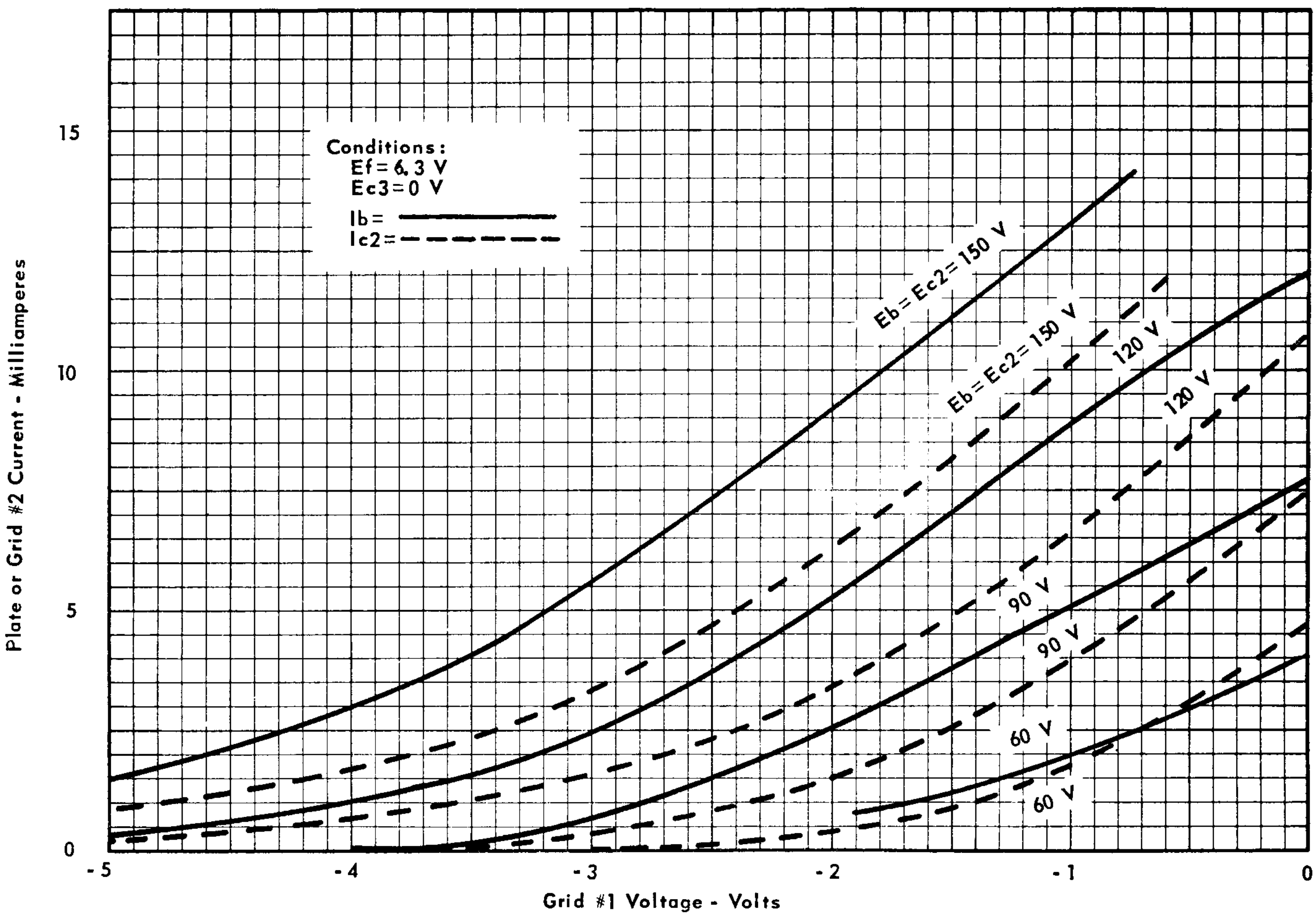


RELIABLE SUBMINIATURE PENTODE

AVERAGE CHARACTERISTICS



AVERAGE CHARACTERISTICS



AVERAGE CHARACTERISTICS

